FIG.1

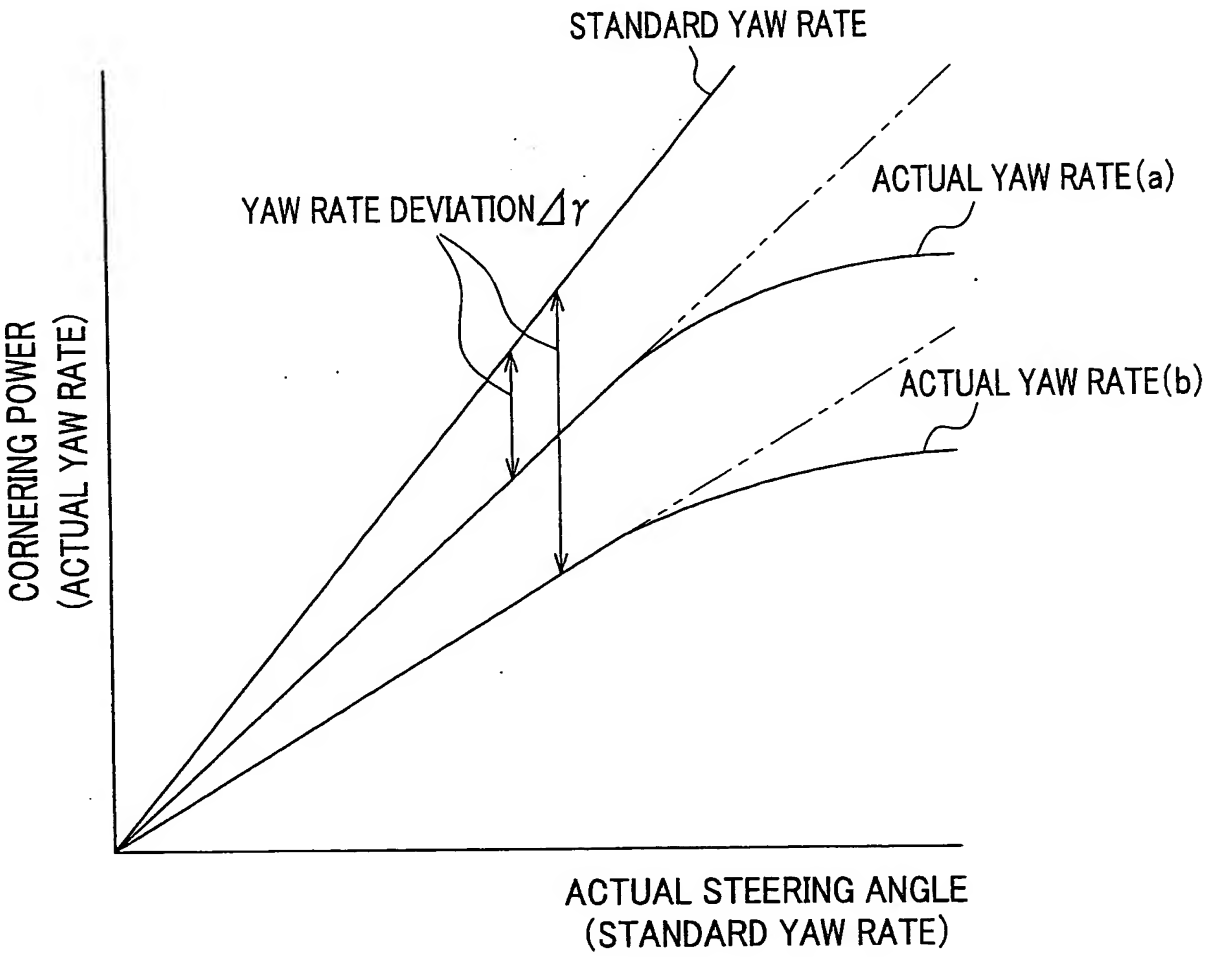

STANDARD YAW RATE
YAW RATE DEVIATION Δγ
ACTUAL YAW RATE(a)
ACTUAL YAW RATE(b)
CORNERING POWER
(ACTUAL YAW RATE)
ACTUAL STEERING ANGLE
(STANDARD YAW RATE)

FIG.2

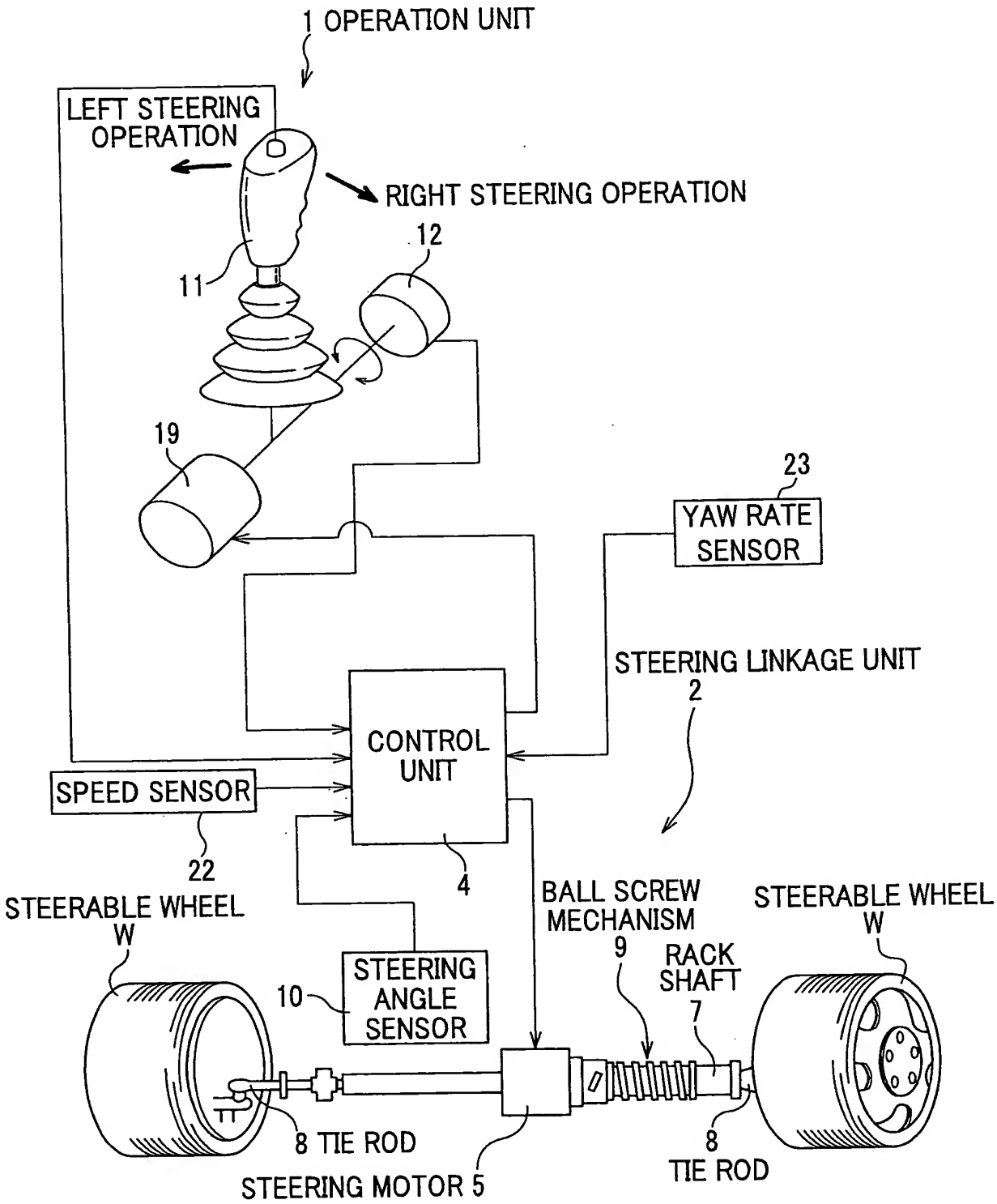

1 OPERATION UNIT
LEFT STEERING OPERATION
RIGHT STEERING OPERATION
11
12
19
23
YAW RATE SENSOR
STEERING LINKAGE UNIT
2
CONTROL UNIT
SPEED SENSOR
22
4
STEERABLE WHEEL W
BALL SCREW MECHANISM
9
RACK SHAFT
7
STEERABLE WHEEL W
10
STEERING ANGLE SENSOR
8 TIE ROD
STEERING MOTOR 5
8
TIE ROD

FIG.3

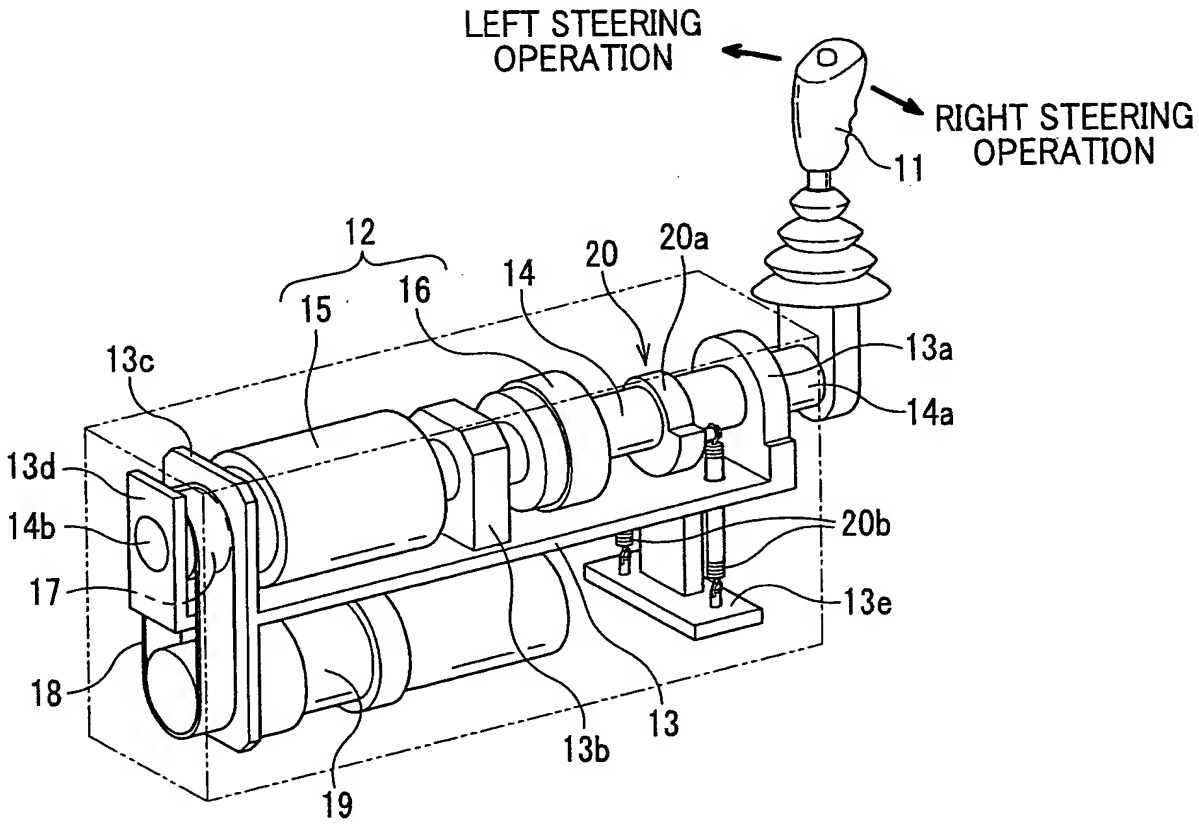

LEFT STEERING OPERATION
RIGHT STEERING OPERATION
11
12
15
16
14
20
20a
13a
14a
13c
13d
14b
17
18
19
13b
13
20b
13e

FIG.4

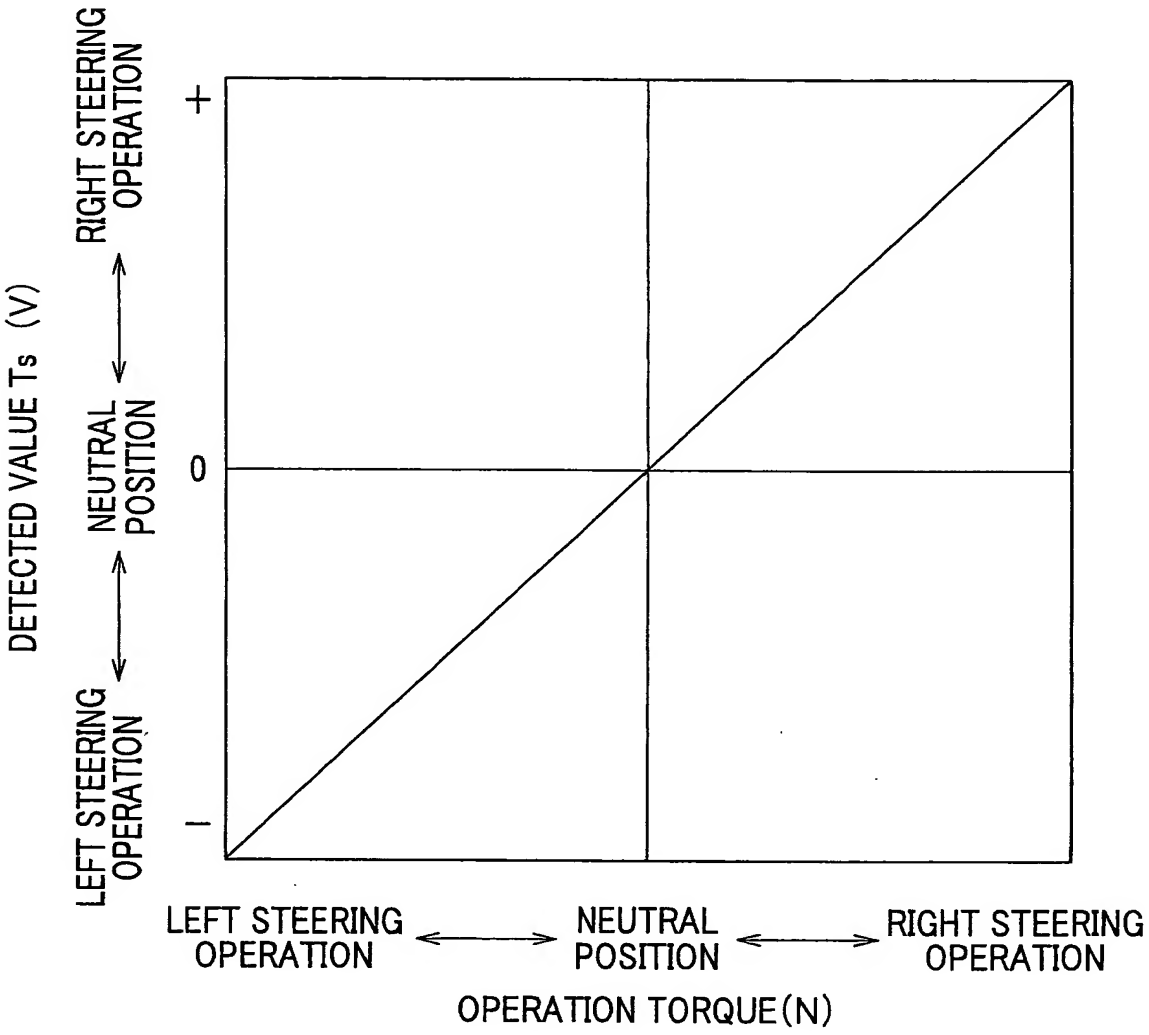

DETECTED VALUE Ts (V)
RIGHT STEERING OPERATION
NEUTRAL POSITION
LEFT STEERING OPERATION
+
0
−
LEFT STEERING OPERATION
NEUTRAL POSITION
RIGHT STEERING OPERATION
OPERATION TORQUE(N)

FIG.5

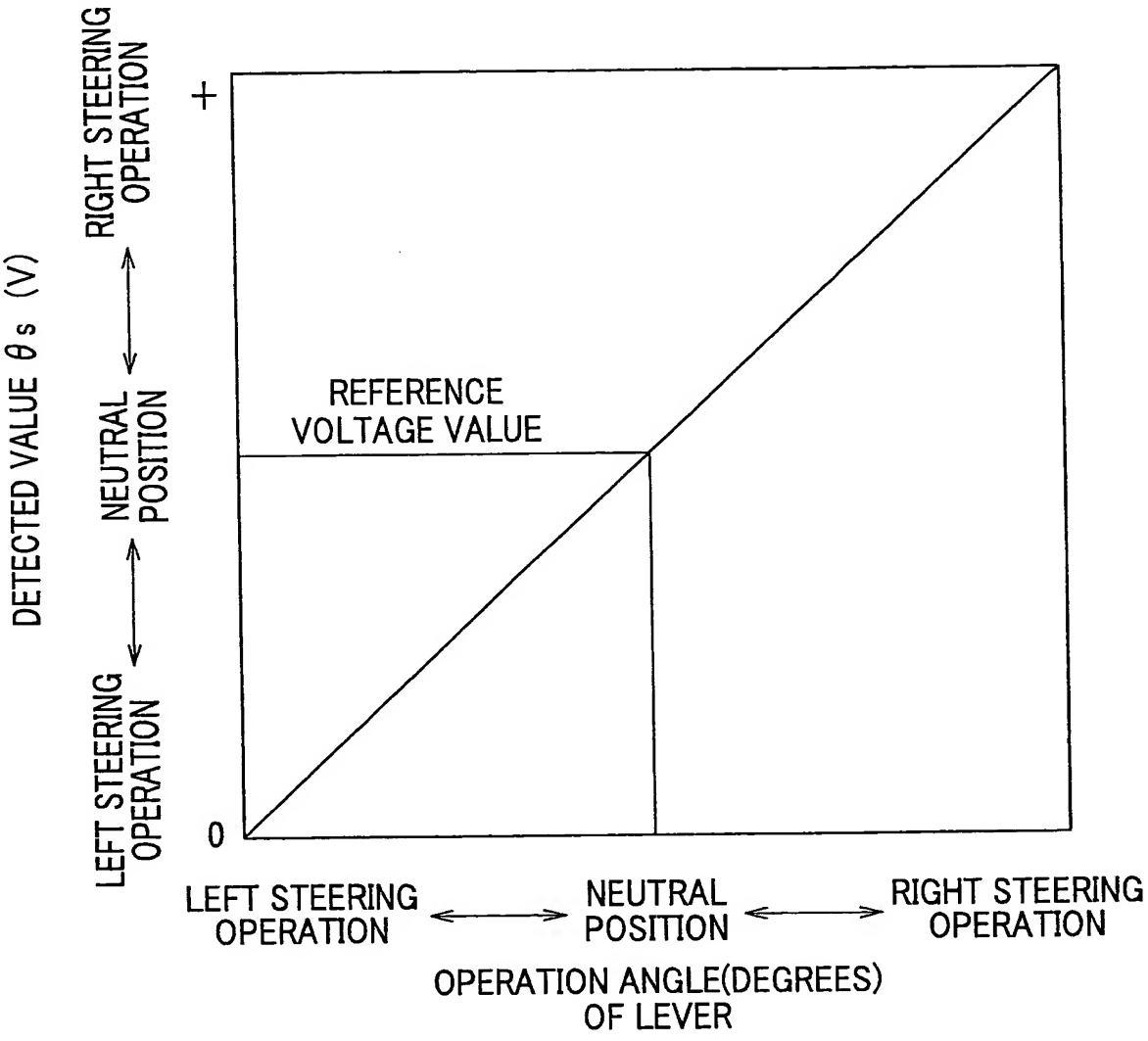

DETECTED VALUE θs (V)
RIGHT STEERING OPERATION
NEUTRAL POSITION
LEFT STEERING OPERATION
+
0
REFERENCE VOLTAGE VALUE
LEFT STEERING OPERATION
NEUTRAL POSITION
RIGHT STEERING OPERATION
OPERATION ANGLE(DEGREES) OF LEVER

FIG.6

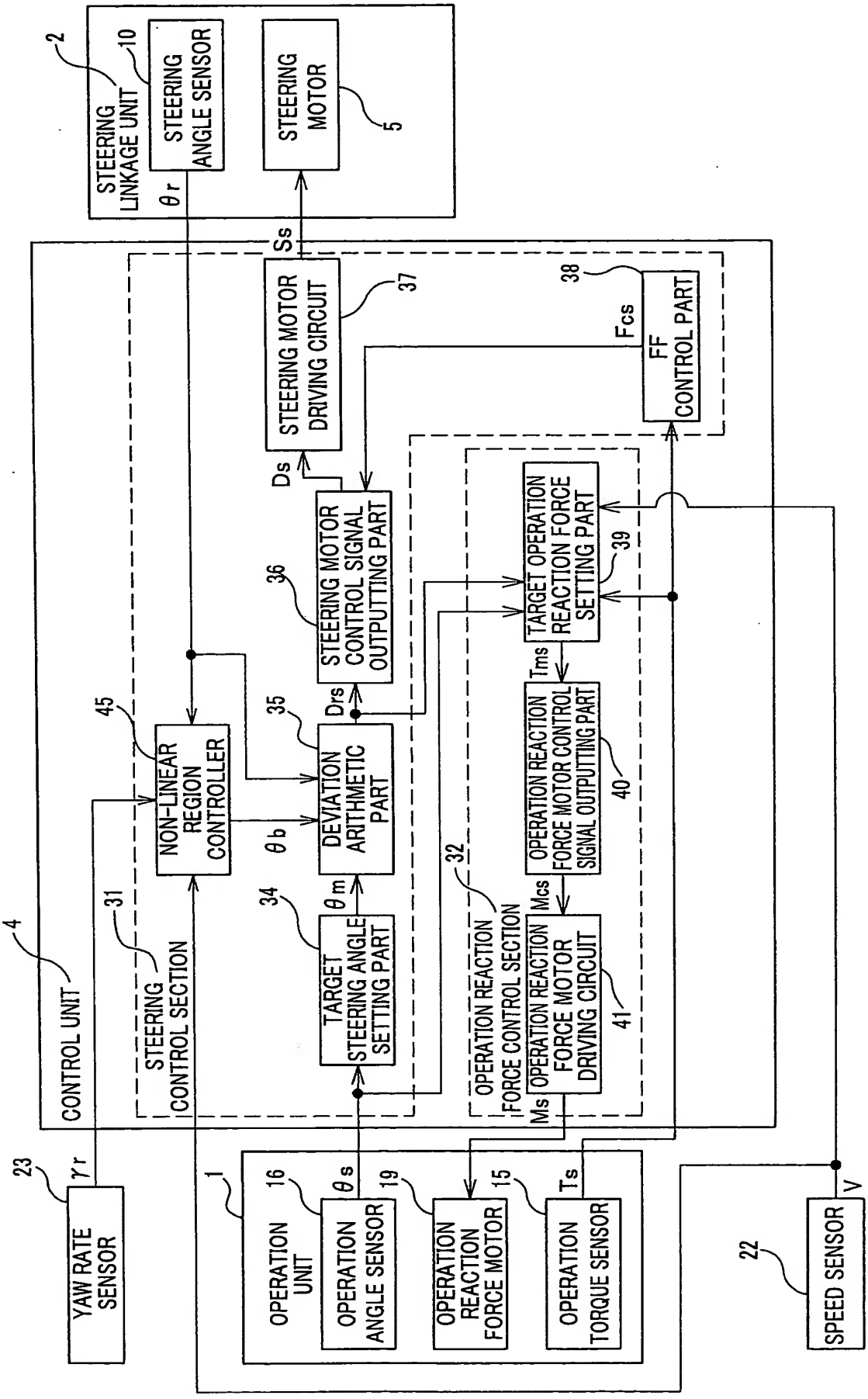

2
STEERING LINKAGE UNIT
10
STEERING ANGLE SENSOR
θr
STEERING MOTOR
5
Ss
4
CONTROL UNIT
STEERING CONTROL SECTION
31
STEERING MOTOR DRIVING CIRCUIT
37
38
Fcs
FF CONTROL PART
Ds
STEERING MOTOR CONTROL SIGNAL OUTPUTTING PART
36
TARGET OPERATION REACTION FORCE SETTING PART
39
45
NON-LINEAR REGION CONTROLLER
35
Drs
DEVIATION ARITHMETIC PART
θb
Tms
OPERATION REACTION FORCE MOTOR CONTROL SIGNAL OUTPUTTING PART
40
34
θm
TARGET STEERING ANGLE SETTING PART
32
OPERATION REACTION FORCE CONTROL SECTION
Mcs
OPERATION REACTION FORCE MOTOR DRIVING CIRCUIT
41
Ms
23
γr
YAW RATE SENSOR
1
OPERATION UNIT
16
θs
OPERATION ANGLE SENSOR
19
OPERATION REACTION FORCE MOTOR
15
Ts
OPERATION TORQUE SENSOR
22
V
SPEED SENSOR

FIG.7

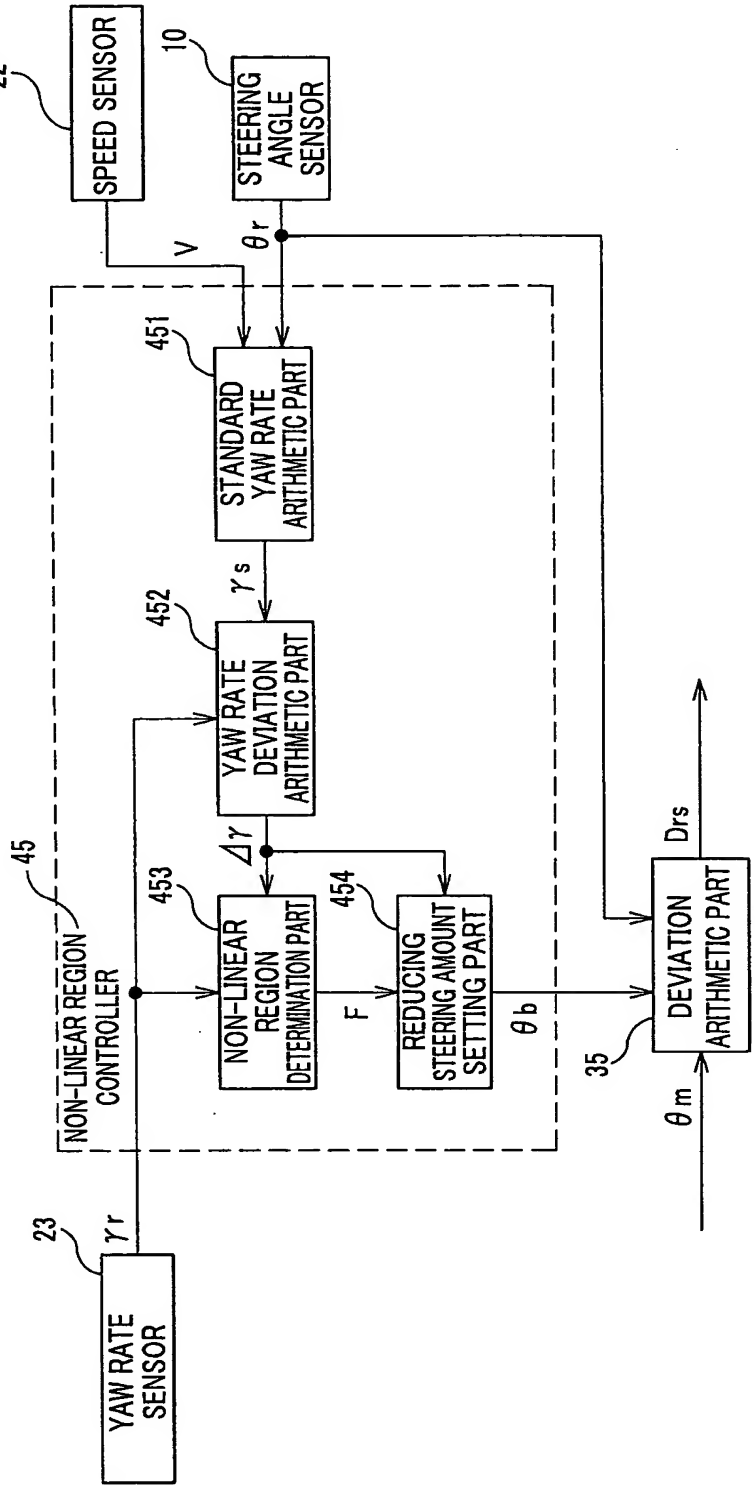

22
SPEED SENSOR
10
STEERING ANGLE SENSOR
V
θr
451
STANDARD YAW RATE ARITHMETIC PART
γs
452
YAW RATE DEVIATION ARITHMETIC PART
Δγ
45
NON-LINEAR REGION CONTROLLER
453
NON-LINEAR REGION DETERMINATION PART
454
REDUCING STEERING AMOUNT SETTING PART
F
θb
Drs
DEVIATION ARITHMETIC PART
35
θm
23
γr
YAW RATE SENSOR

FIG.8

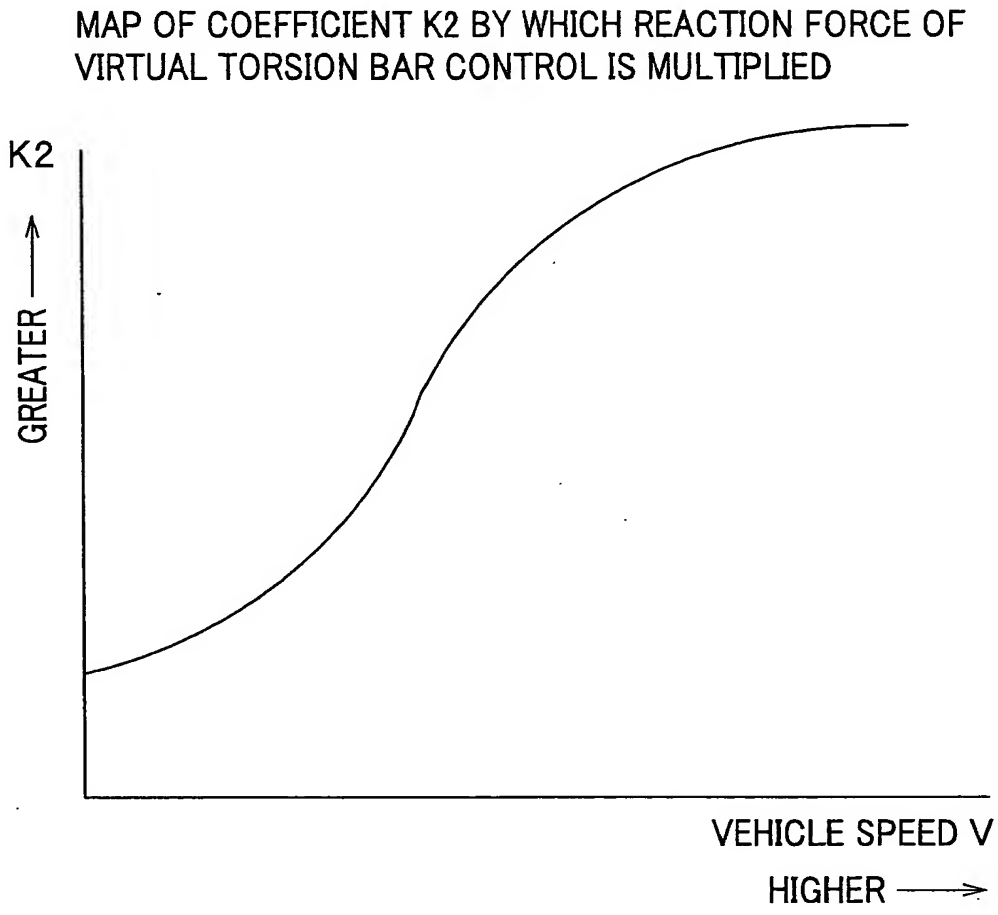

MAP OF COEFFICIENT K2 BY WHICH REACTION FORCE OF VIRTUAL TORSION BAR CONTROL IS MULTIPLIED
K2
GREATER
VEHICLE SPEED V
HIGHER

FIG.9

MAP OF COEFFICIENT K3 BY WHICH REACTION FORCE OF VIRTUAL TORSION BAR CONTROL IS MULTIPLIED

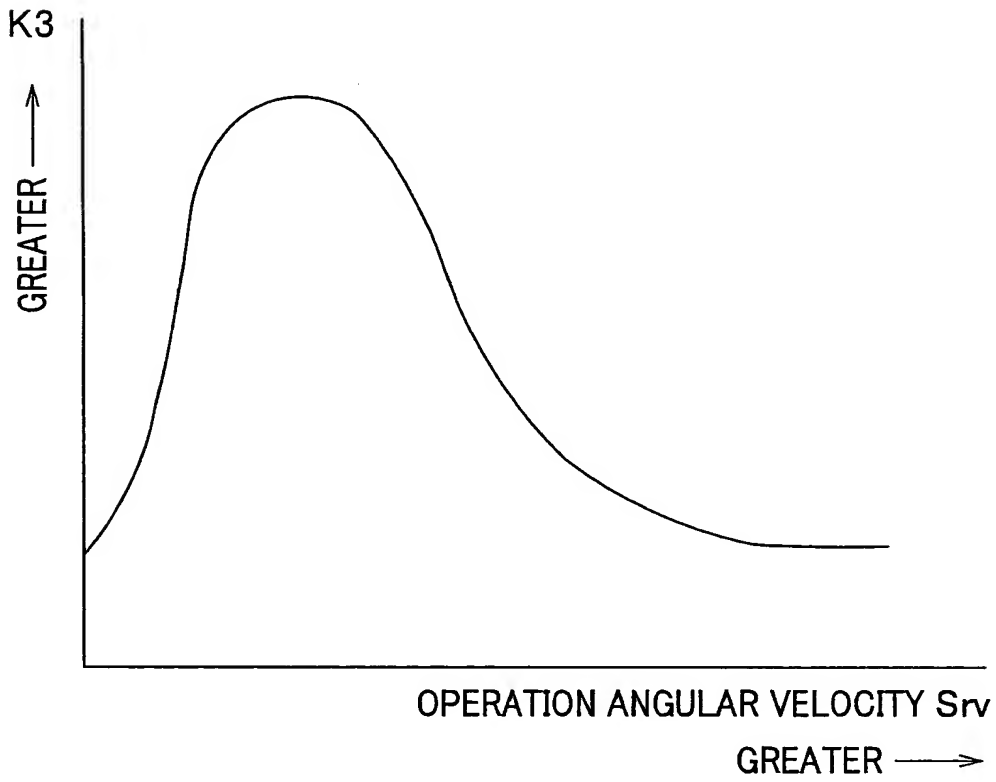


FIG.10

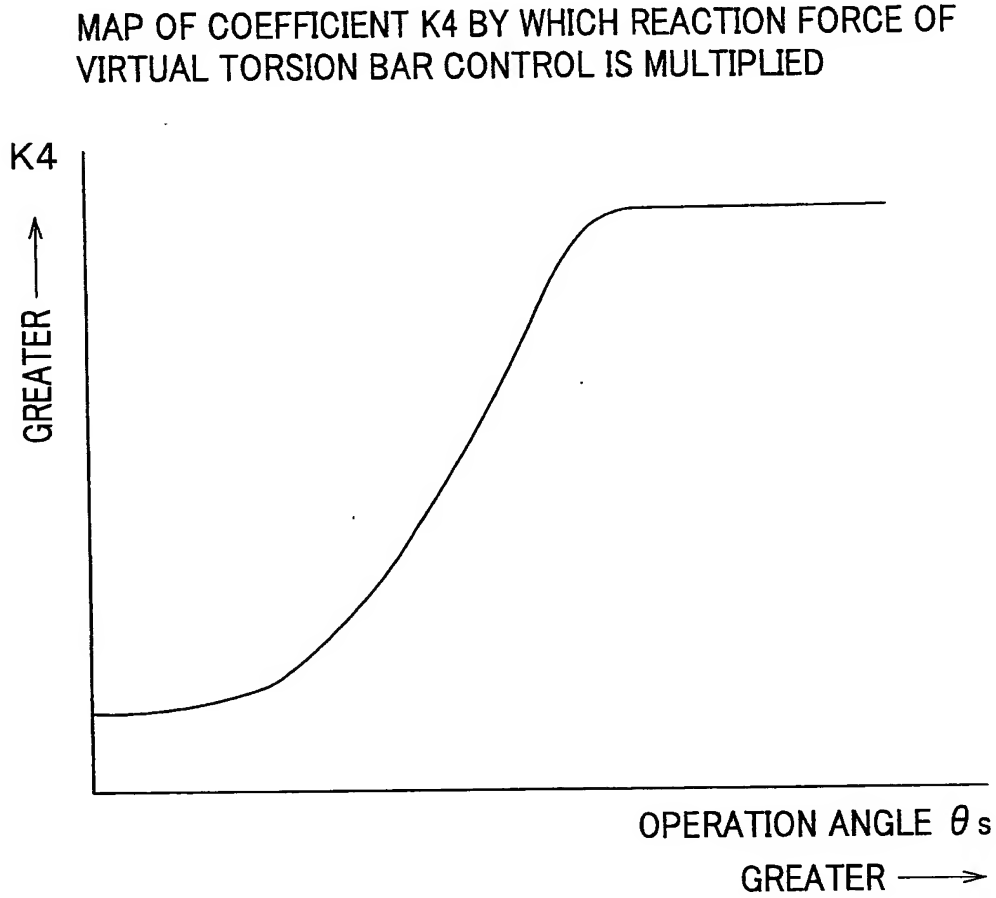

MAP OF COEFFICIENT K4 BY WHICH REACTION FORCE OF VIRTUAL TORSION BAR CONTROL IS MULTIPLIED
K4
GREATER
OPERATION ANGLE θs
GREATER

FIG.11

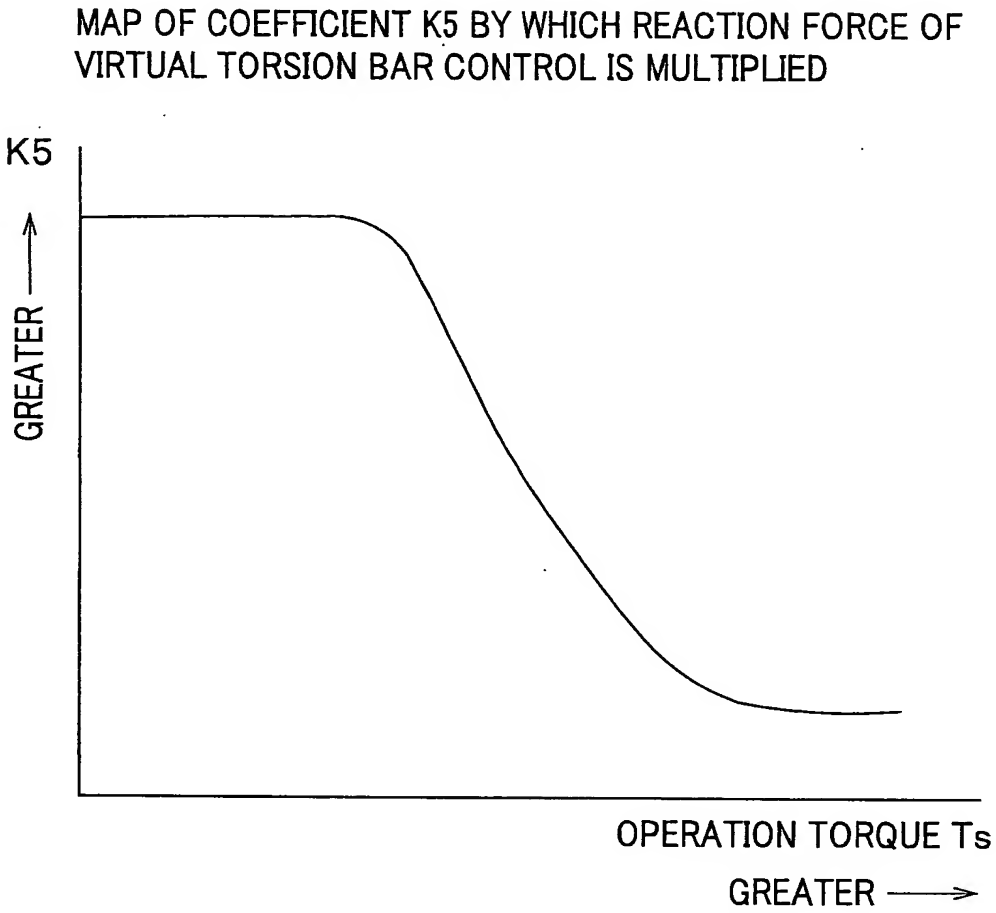

MAP OF COEFFICIENT K5 BY WHICH REACTION FORCE OF VIRTUAL TORSION BAR CONTROL IS MULTIPLIED
K5
GREATER
OPERATION TORQUE Ts
GREATER

FIG.12

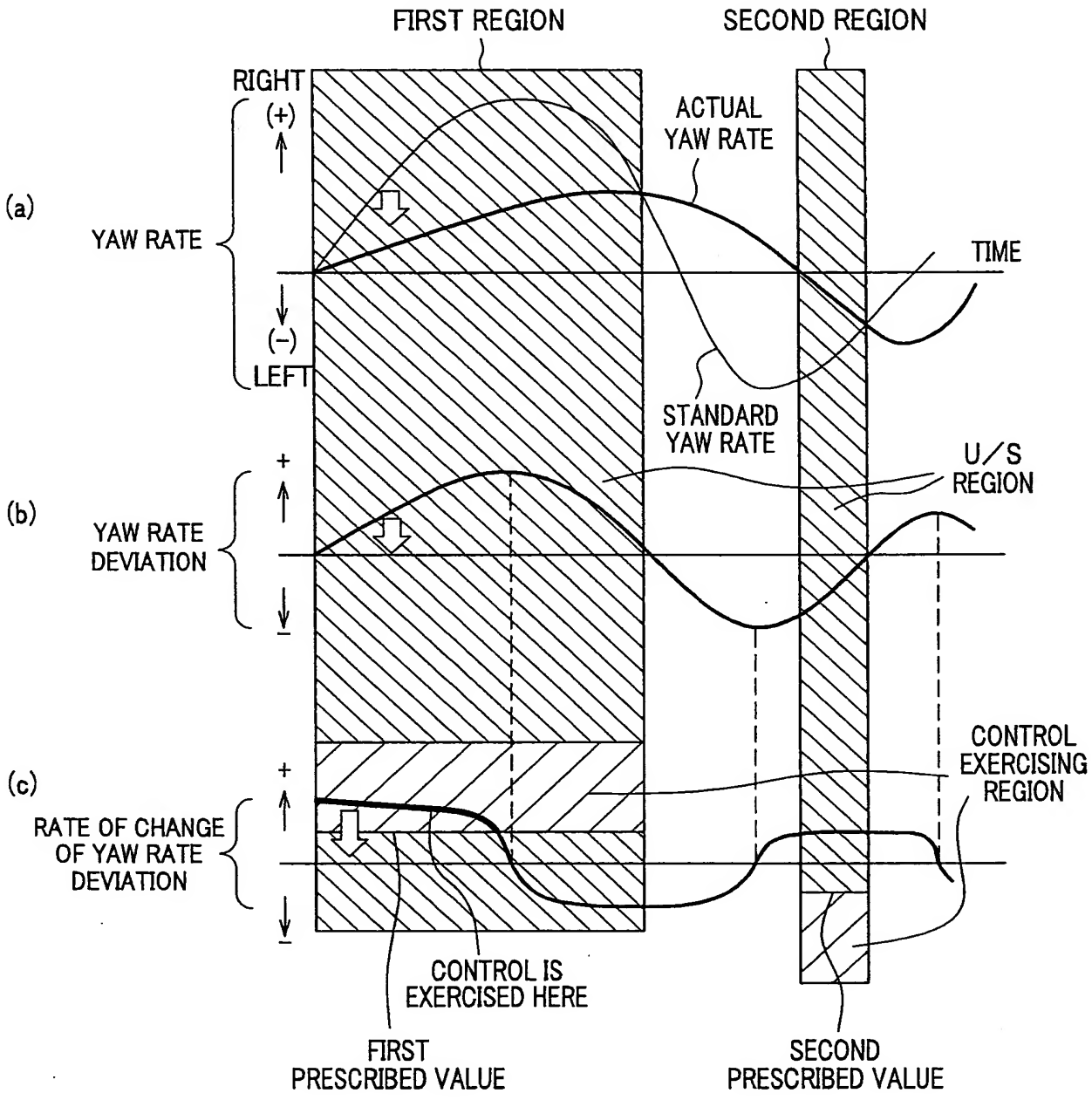

FIRST REGION
SECOND REGION
RIGHT
(+)
(a)
YAW RATE
(−)
LEFT
ACTUAL YAW RATE
TIME
STANDARD YAW RATE
U/S REGION
+
(b)
YAW RATE DEVIATION
CONTROL EXERCISING REGION
+
(c)
RATE OF CHANGE OF YAW RATE DEVIATION
CONTROL IS EXERCISED HERE
FIRST PRESCRIBED VALUE
SECOND PRESCRIBED VALUE

FIG.13

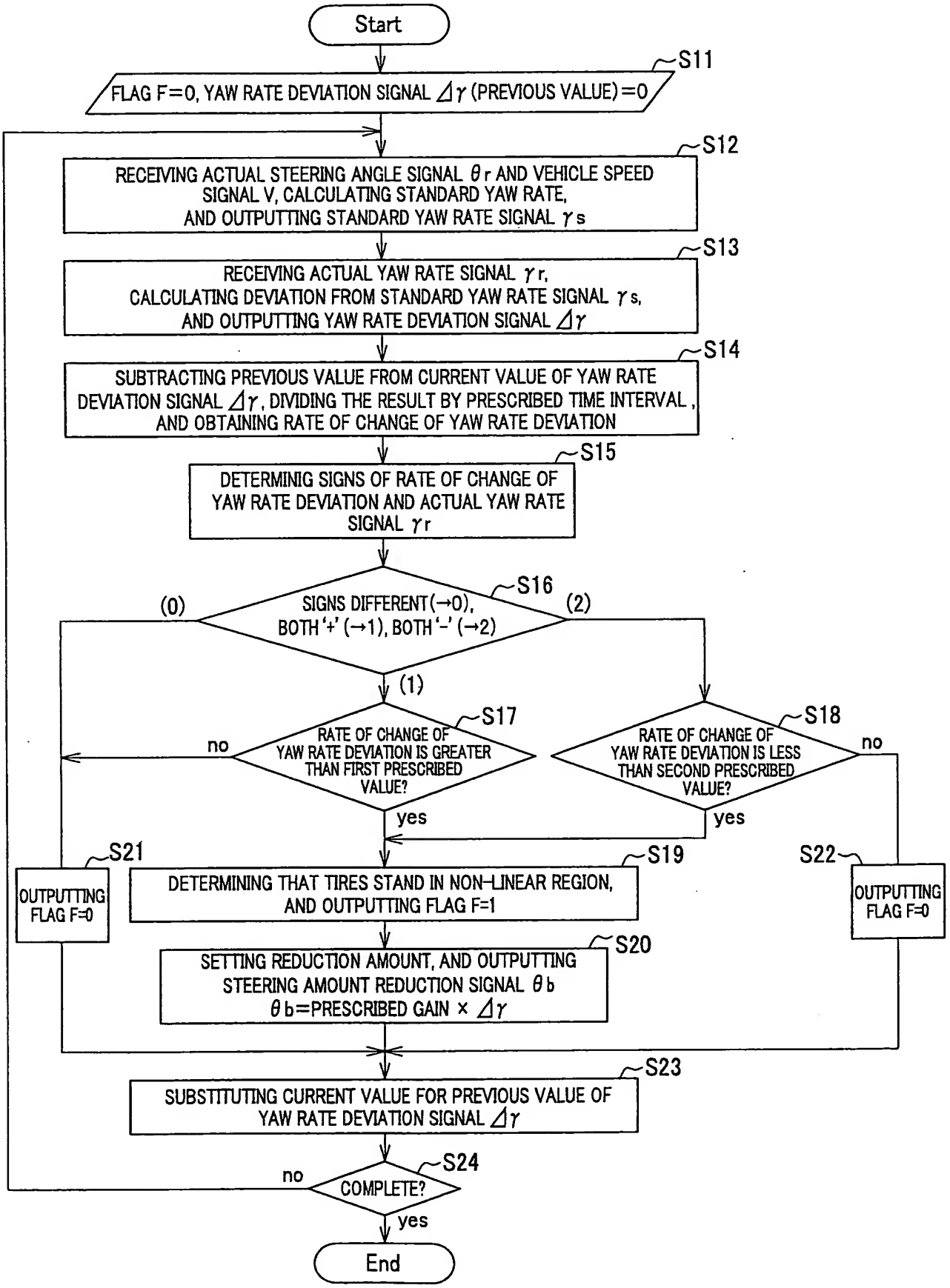
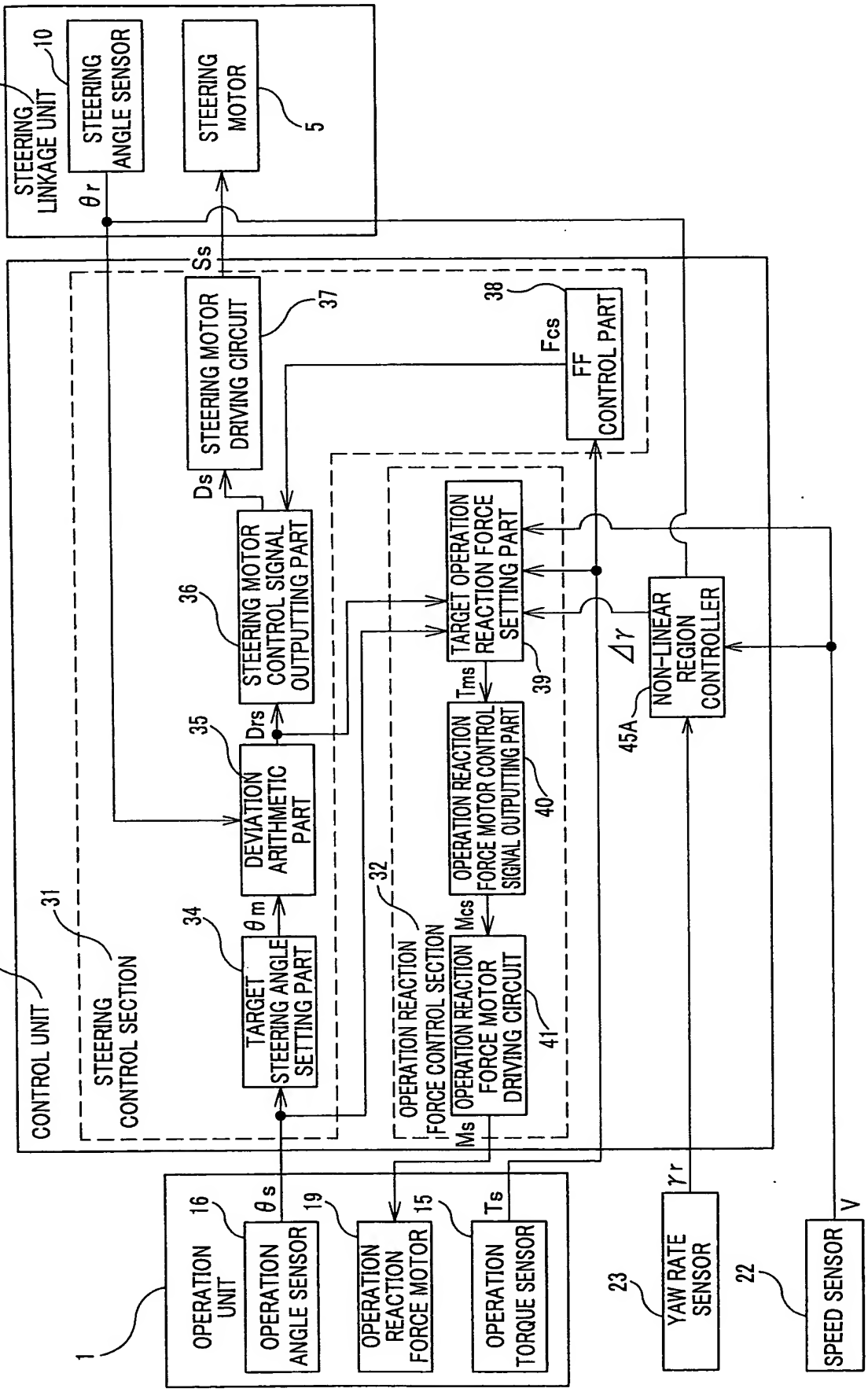

Start
S11
FLAG F=0, YAW RATE DEVIATION SIGNAL Δγ (PREVIOUS VALUE)=0
S12
RECEIVING ACTUAL STEERING ANGLE SIGNAL θr AND VEHICLE SPEED SIGNAL V, CALCULATING STANDARD YAW RATE, AND OUTPUTTING STANDARD YAW RATE SIGNAL γs
S13
RECEIVING ACTUAL YAW RATE SIGNAL γr, CALCULATING DEVIATION FROM STANDARD YAW RATE SIGNAL γs, AND OUTPUTTING YAW RATE DEVIATION SIGNAL Δγ
S14
SUBTRACTING PREVIOUS VALUE FROM CURRENT VALUE OF YAW RATE DEVIATION SIGNAL Δγ, DIVIDING THE RESULT BY PRESCRIBED TIME INTERVAL, AND OBTAINING RATE OF CHANGE OF YAW RATE DEVIATION
S15
DETERMINIG SIGNS OF RATE OF CHANGE OF YAW RATE DEVIATION AND ACTUAL YAW RATE SIGNAL γr
S16
SIGNS DIFFERENT(→0), BOTH '+' (→1), BOTH '-' (→2)
(0)
(1)
(2)
S17
RATE OF CHANGE OF YAW RATE DEVIATION IS GREATER THAN FIRST PRESCRIBED VALUE?
no
yes
S18
RATE OF CHANGE OF YAW RATE DEVIATION IS LESS THAN SECOND PRESCRIBED VALUE?
no
yes
S21
OUTPUTTING FLAG F=0
S19
DETERMINING THAT TIRES STAND IN NON-LINEAR REGION, AND OUTPUTTING FLAG F=1
S22
OUTPUTTING FLAG F=0
S20
SETTING REDUCTION AMOUNT, AND OUTPUTTING STEERING AMOUNT REDUCTION SIGNAL θb
θb=PRESCRIBED GAIN × Δγ
S23
SUBSTITUTING CURRENT VALUE FOR PREVIOUS VALUE OF YAW RATE DEVIATION SIGNAL Δγ
S24
COMPLETE?
no
yes
End

FIG.14


2
STEERING LINKAGE UNIT
10
STEERING ANGLE SENSOR
θr
STEERING MOTOR
5
Ss
4
CONTROL UNIT
31
STEERING CONTROL SECTION
STEERING MOTOR DRIVING CIRCUIT
37
38
Fcs
FF CONTROL PART
Ds
36
STEERING MOTOR CONTROL SIGNAL OUTPUTTING PART
TARGET OPERATION REACTION FORCE SETTING PART
39
Δγ
NON-LINEAR REGION CONTROLLER
45A
Tms
35
Drs
DEVIATION ARITHMETIC PART
OPERATION REACTION FORCE MOTOR CONTROL SIGNAL OUTPUTTING PART
40
34
θm
TARGET STEERING ANGLE SETTING PART
32
OPERATION REACTION FORCE CONTROL SECTION
Mcs
OPERATION REACTION FORCE MOTOR DRIVING CIRCUIT
41
Ms
1
OPERATION UNIT
16
θs
OPERATION ANGLE SENSOR
19
OPERATION REACTION FORCE MOTOR
15
Ts
OPERATION TORQUE SENSOR
γr
23
YAW RATE SENSOR
22
V
SPEED SENSOR